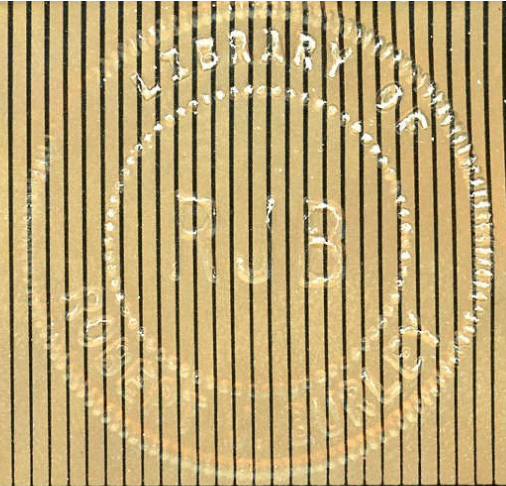


OWNER'S MANUAL



SC-40 SCIENTIFIC CALCULATOR

YOUR SC-40 SCIENTIFIC CALCULATOR is especially designed for use by scientists, engineers, statisticians and those who require a pocket-sized, reliable, precision computation instrument capable of **transcendental** function performance.

This unique, compact, and unusually complex system with a total of **eight data registers** is not only capable of performing almost all functions in various fields of technology, but also is extremely simple to operate since it employs the **true algebraic notation entry method**. The signs, numbers in full floating decimal point or scientific notation, function instructions, and even the **brackets** and **parentheses** are repeatedly entered exactly in the same sequence as the problems would be stated. This means that no reprogramming of the problems is necessary prior to beginning operation.

The **five-memory system** of the SC-40 is powerful too. The two sub-memory registers back up the bracket and parenthesis keys for automatic bracketing and parenthesizing sub-problems. The ten digit precision values of π (pi) and e (epsilon) are stored as fixed memories for instant recall. In addition, a separate memory register is provided for storing any data or constant at your option, for intermediate calculation result of ten digit mantissa and two digit exponent—for high efficiency in processing large amounts of data and problems, or for a rare complex problem. Yet, this extraordinary system consumes very little energy. The special built-in **computer-controlled energy saving system** controls and allocates power according to the minimum energy demand by the SC-40, depending on each phase of operation.

FEATURES

- Data entry and display in range of $\pm 1 \times 10^{-9.9}$ to $\pm (10 - 10^{-9}) \times 10^{9.9}$
- Answer in ten significant mantissa and two exponent digits.
- Automatic selection of floating decimal point or scientific notation for result display.
- Answer in true credit balance.
- Problem entry with true algebraic notation.
- Number entry in full floating decimal point.
- Number entry in scientific notation.
- Double entry proof.
- X^2 , $\sqrt{X}$ and $1/X$ functions.
- Exponential functions.
- Logarithmic functions.
- Trigonometric functions.
- Inverse trigonometric functions.
- Angle unit both in radian and degree.
- Fixed memory for 10-digit precision $\pi (=3.141592654)$
- Fixed memory for 10-digit precision $e (=2.718281828)$
- 2 ■ Two sub-memory registers for automatic bracketing and parenthesizing.
- Extra memory register for storage of optional constants or intermediate calculation results.
- Radian-degree indicator.
- Automatic busy/ready indicator.
- Automatic error indication.
- Automatic result overflow indication.
- Automatic display shut-off and indication.
- Automatic *Lo-battery* indicator.
- Conveniently dual-sectioned keyboard for arithmetic and scientific functions features feather touch and full size for fast and accurate operation.
- Special low power and high reliability type 14-digit LED display.
- Built-in computer-controlled energy saving circuit.
- Low power consumption.
- Built-in rechargeable battery and charger.
- Compact and light weight.
- Convenient protective carrying case.

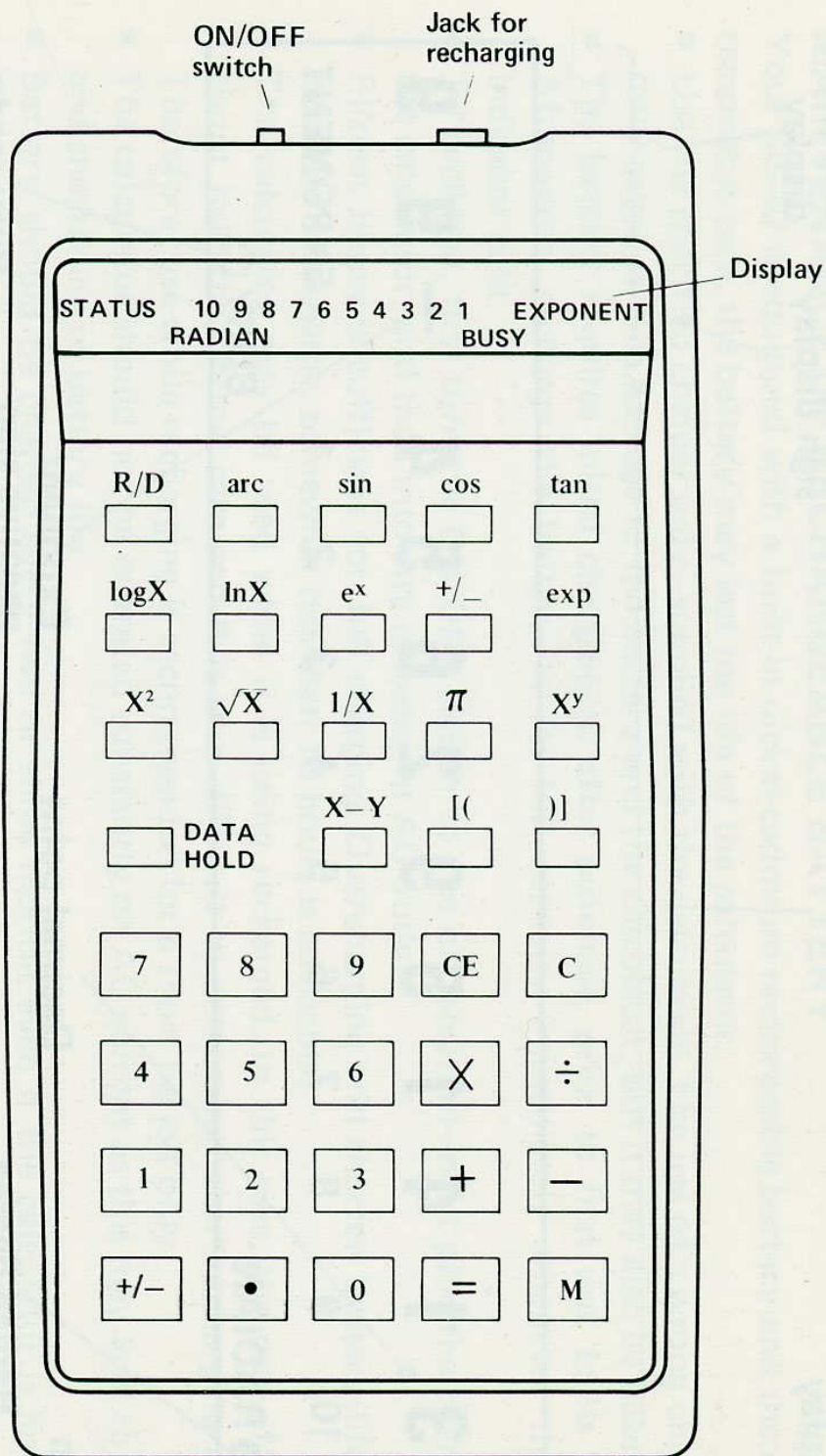


Figure 1

NOTE: THE BATTERY REQUIRES INITIAL CHARGING-UP AFTER PURCHASE, PRIOR TO FIRST USE.

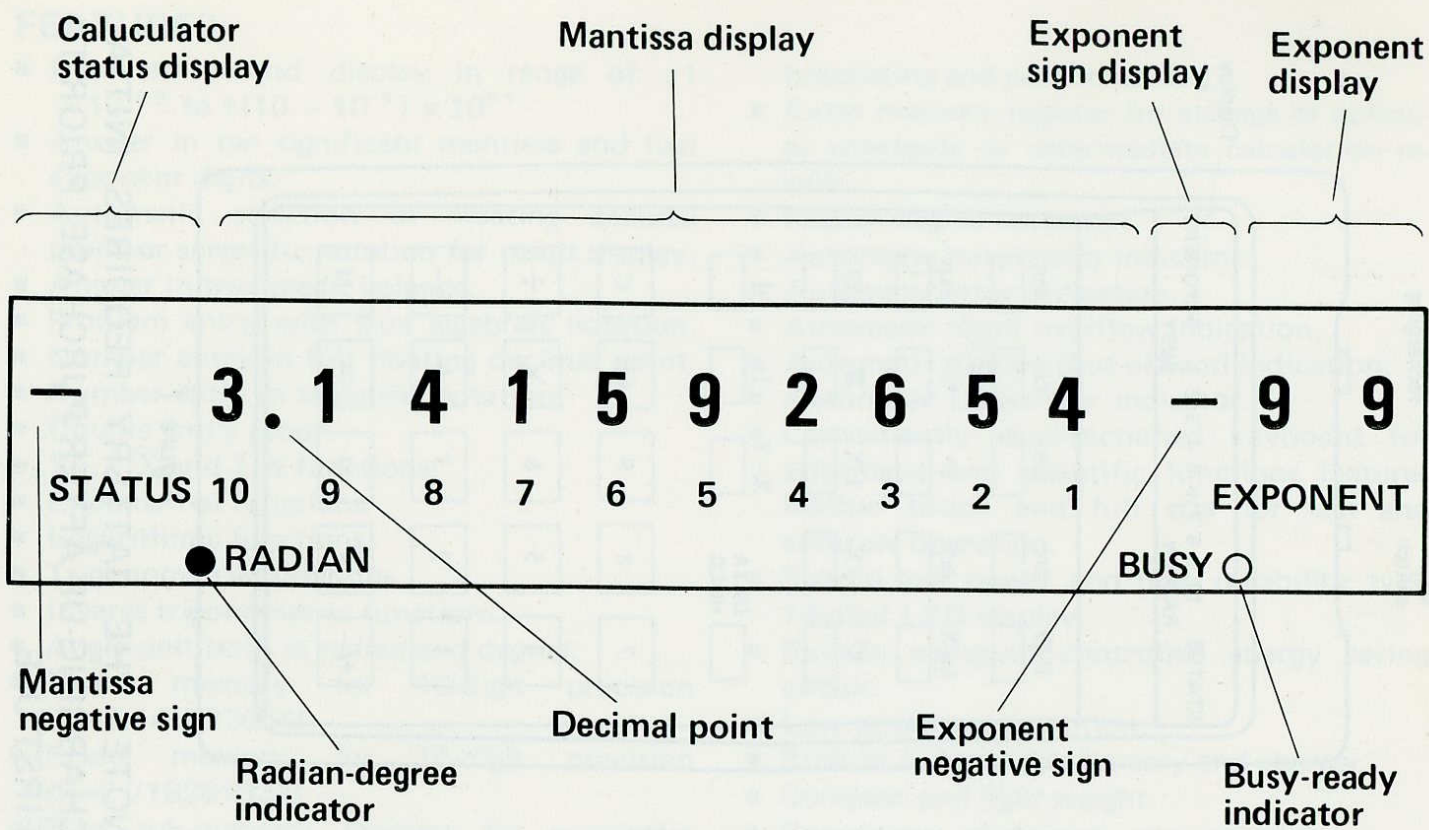


Figure 2

MAINTENANCE OF RECHARGEABLE BATTERY

Your SC-40 is equipped with a built-in nickel-cadmium rechargeable battery and the charger. With reasonable care, the battery may last the life of the calculator.

- Use the specified charger only—supplied with the calculator. The use of a wrong charger may not only cause **serious damage** to the battery and the calculator, but it may also be **hazardous**.
- **The battery requires initial charging-up after purchase, prior to first use, to its full capacity.** Afterwards, recharge the battery to its full capacity immediately whenever the *Lo-battery* indicator is lit.
- To recharge, first turn the ON/OFF switch to the off position—next plug the charger cord into the calculator, and then into any convenient AC outlet.
- Fifteen hours is sufficient for full charging. Overcharging will shorten battery life. To avoid a possible overcharge, somewhat less than 15 hours is advisable.
- The calculator may be used while it is being recharged. In this case, the rate of recharging is about half the normal rate and it is thus difficult to determine when recharging is completed. Therefore, use while recharging is recommended for a short period only.
- The calculator should not be operated constantly on AC current as this may lead to overcharging and shortening of battery life.
- Battery should be charged every two or three months even if the calculator is not being used. Full recharging is recommended before storing the calculator for any length of time.
- **For servicing, refer to qualified service personnel.**

OPERATING INSTRUCTIONS

ENTRY FORMAT OF THE SC-40

As a feature of the SC-40, the **true algebraic notation entry method** is employed. All numbers may be entered and displayed in the **sign-magnitude format**, either in **full floating decimal point** or **scientific notation**. Any of the two-variable function instructions and **parentheses** or **both brackets and parentheses** may be entered exactly in the same sequence as the problem is stated. The two **sub-memory registers** exclusively for the **bracket and parenthesis keys** automatically parenthesize and process sub-problems up to two parentheses levels without disruptive complicated manual memory operations.

AUTOMATIC CLEARING FEATURE OF THE SC-40

For starting a new problem, any number entry (either positive or negative), automatically clears the calculator if the previous calculation result was terminated by the  key or any of the **single variable function** keys.

ON/OFF SWITCH—To turn the calculator on, simply slide the switch to the **right**. To turn the calculator off, slide the switch to the **left** into its original position. The power-on condition is indicated by the illumination of the first digit in the mantissa on the right of the display. After the calculator is turned on, always press the clear key before entering any calculation operation. This resets it to zero, and thereafter, all the data and function instruction registers which are not visible except for the display register. After calculations are finished, make sure to turn the switch to the "OFF" position to prevent battery drain.

- C** **CLEAR KEY**—This clears all data and function instructions in the calculator (except the data stored in the memory), and resets the calculator to zero for the start of a new problem.
- CE** **CLEAR ENTRY KEY**—This clears the preceding number entry only and conditions the calculator to accept a new number entry.
- +/-**, **+/-** **SIGN CHANGE KEY**—These keys change the **sign of the mantissa** anytime they are pressed while the mantissa portion is in progress and the **sign of the exponent** anytime if pressed while the exponent portion of the number is in progress, from positive to negative, or vice versa. Functionally, these keys are identical, but for sake of convenience, they are located in both the arithmetic keyboard section and in the scientific keyboard section. **+/-** is located in the section of the number entry keys while **+/-** is adjacent to the exponent key, assuring the user of a quick and convenient means of entering a negative exponent. Note: These keys automatically clear the calculator if pressed after the **=** key or any of the **single variable function keys**.
- **DECIMAL POINT KEY**—This enters a decimal point to the mantissa display in its proper place, when entering a number. Note: An attempt to enter the decimal point to the exponent display will simply be ignored.
- 0** to **9** **NUMBER ENTRY KEYS**—These enter numbers 0 through 9 to a limit of a 10-digit mantissa and a 2-digit exponent. Note: All numbers may be entered in the **sign-magnitude**

format with **algebraic notation** in exactly the same sequence as a problem would be written. For example, if a problem is: $(-3) + (-2) = -5$, the key sequence would be: $\boxed{+/-}$
 $\boxed{3} \boxed{+} \boxed{+/-} \boxed{2} \boxed{=}$.

$\boxed{\pi}$ **PI KEY**—This enters the 10-digit precision value of π (3.141592654) to the mantissa display. Note: This key following a number entry clears the number entered and causes the immediate entry of the π .

$\boxed{\text{exp}}$ **EXPONENT KEY**—This instructs the calculator to accept the subsequent number to be entered as an exponent of 10, when the number is to be entered in **scientific notation**. This condition reverts automatically upon proceeding to a subsequent function key. Note: Either positive or negative numbers of two integer digits which are produced only by the number entry keys, are accepted as an exponent. Entry beyond two digits or the decimal point will simply be ignored. The $\boxed{M}$ or $\boxed{\pi}$ key, if attempting to enter either of them as an exponent, will simply replace the previously entered mantissa portion of the number and no exponent entry will result.

$\boxed{X \leftrightarrow Y}$ **FACTOR CHANGE KEY**—This interchanges the two factors entered and stored in the calculator, for any of two variable functions, if pressed prior to the $\boxed{=}$ key or the following function key.

$\boxed{[()]}$ **OPEN-BRACKET AND PARENTHESIS KEY**—This enters the open-parenthesis or both the open-bracket and the open-parenthesis if pressed prior to a sub-problem, in the same

manner as the problem is stated. Pressing the key once enters an open-parenthesis and pressing the key twice enters both the open-bracket and the open-parenthesis in the sequence. This key actually causes storage of the intermediate result and prior function into the **sub-memory**, and immediately conditions the calculator to execute sub-problems within parentheses. Note: An attempt to open more than two levels of parentheses results in an immediate **error status** of the calculator.

)] **CLOSED-PARENTHESIS AND BRACKET KEY**—This enters the closed-parenthesis or the closed-parenthesis and the closed-bracket if pressed following the sub-problem, in the same manner as the problem is stated. Pressing this key once enters the closed-parenthesis and pressing this key twice enters both the closed-parenthesis and the closed-bracket in the sequence. This key actually causes the execution of a prior function and display of the result of the sub-problem within parentheses and causes a recall of the previous intermediate result and prior function stored in the **sub-memories** at the time the **[(** key was pressed.

= **EQUAL KEY**—This instructs the calculator to execute any of the two-variable functions previously instructed.

= **M** **STORING DISPLAYED DATA INTO MEMORY**—Pressing the **M** key after the **=** key always causes storage of the data displayed into the memory. The new data always replaces the previous data stored in the memory. Thus, the memory need never be cleared. **9**

M **MEMORY KEY**—This enters the data stored in the memory into the **display** at any time except following the **=** key. The memory retains the previous data, until new data replaces the previous data, without being affected by the **C** or **CE** key. However, the data in the memory will not remain after the calculator is turned off. Note: The **M** key following any number entry clears the number entered and causes immediate entry of the data stored in the memory to the display. The number entry following the **M** key is accepted as additional fractional digits to the data from the memory.

TWO-VARIABLE FUNCTION KEYS

Any two-variable function key, during chain calculations, completes any previous function instructions, the same as an “equal” function, and then instructs the calculator what the next function will be.

+ **ADD KEY**—This instructs the calculator to add the following number entered to the preceding number entered.

− **SUBTRACT KEY**—This instructs the calculator to subtract the following number entered from the preceding number entered.

X **MULTIPLY KEY**—This instructs the calculator to multiply the preceding number entered by the following number entered.

$\div$ **DIVIDE KEY**—This instructs the calculator to divide the preceding number entered by the following number entered.

X^Y **X-to-the-Y KEY**—This instructs the calculator to compute the Y-th **power** of the previously entered number or calculation result where Y is the number to be entered after this key.

ERROR CORRECTION FEATURE OF THE SC-40

Any number entry may be erased by pressing the CE key following the number to be revised without affecting the function instruction and the preceding data stored in the calculator. This key also conditions the calculator to accept a revised number entry.

Any two-variable function instruction may be revised by following a new function key.

If the wrong function key has already been followed by the subsequent number entry; press the CE key, and then press the correct function instruction key, and finally repeat the number entry which was erased by the CE key.

If the **prior factor** needs to be revised after a function instruction and the following factor have been entered, press the $X-Y$ key, the CE key, in sequence, and enter a revised number, and then press the $X-Y$ key again.

SINGLE VARIABLE FUNCTION KEYS

Any single variable function key immediately executes the computation for the function of the previously entered number, or calculation result terminated by the [=] key.

The execution of a single variable function, during chain calculation, does not affect any prior function instruction and the preceding number entered and stored in the calculator.

If a single variable function of a previous calculation result is needed, be sure to complete the previous calculation with the [=] key, prior to the single variable function key.

If any of the **single function keys** and the **memory key** are applied in the following specific key sequence;

(1) **data** (2) **equal** (3) **memory** (4) **single variable function** (5) **memory**

the data stored into the memory before the **single variable function key** will be replaced by the result of the single variable function.

If the original data entered and stored in the memory is desired to remain unchanged, the **clear key** should be used in the following key sequence;

(1) **data** (2) **equal** (3) **memory** (4) **clear** (5) **memory** (6) **single variable function** (7) **memory** or

(1) **data** (2) **equal** (3) **memory** (4) **single variable function** (5) **clear** (6) **memory**.

X^2

SQUARE KEY—This instructs the calculator for immediate computation of the square function of the displayed number.

- $\sqrt{X}$ **SQUARE ROOT KEY**—This instructs the calculator for immediate computation of the square function of the displayed number.
- $1/X$ **RECIPROCAL KEY**—This instructs the calculator for immediate computation of the reciprocal functions of the displayed number.
- e^X **e-to-the-X KEY**—This instructs the calculator to compute the exponential function of the displayed number.
- 1 e^X —This enters the ten-digit precision value of the e (2.718281828).
- $\ln X$ **NATURAL LOG KEY**—This instructs the calculator to compute the natural logarithm of the displayed number.
- $\log X$ **COMMON LOG KEY**—This instructs the calculator to compute the common logarithm of the displayed number.
- $\sin$ **SINE KEY**—This instructs the calculator to compute the sine of the displayed number.
- $\cos$ **COSINE KEY**—This instructs the calculator to compute the cosine of the displayed number.
- $\tan$ **TANGENT KEY**—This instructs the calculator to compute the tangent of the displayed number.
- arc **INVERSE KEY**—This selects the **inverse trigonometric function** of this key is pressed prior to a **trigonometric** function key.
- R/D **RADIAN-DEGREE KEY**—If pressed once, this key changes the unit of angle from **degree** to **radian** in trigonometric function, resulting in the illumination of the **radian indicator**. The unit reverts to **degree** when this key is pressed again.

DH **DISPLAY HOLD KEY**—This disables the **automatic display shut-off** while being pressed. Releasing this key allows for the **automatic display shut-off** and the display will be shut off in approximately 15 seconds if no other key is pressed.

DISPLAY FORMAT OF THE SC-40 *(Refer to Fig. 2)*

The display consists of a 14 digit alpha-numeric LED display and two LED indicators capable of displaying 10 digits of numbers with the full floating decimal point and two digits of exponent of 10. In addition, there are various information symbols and signs to indicate every condition of the calculator.

BUSY/READY INDICATOR—This indicates that the calculator is performing a calculation and is **busy**. When the indicator is lit, no entry can be accepted. When the calculator completes calculations, the indicator goes off automatically and the calculator becomes **ready** to accept another entry.

DEGREE-RADIAN INDICATOR—This indicates that the calculator is selected to be in the **radian** mode. When the radian mode is selected, a number entered for representing angle is regarded by the calculator as in **radian**, and the results of inverse trigonometric functions displayed are in **radian**, rather than degree.

STATUS INFORMATION SYMBOLS

Specific symbols and signs are displayed in the left most digit or exponent sign display to indicate every status of the calculator. See Fig. 2.

Left most digit	Exponent sign digit	
—		Mantissa negative sign
	—	Exponent negative sign
▢ and 0.		Error symbol
▢ and result.		Result overflow
▢ and result.		Negative result overflow
	—	Display shut-off indication
L		Lo-battery indication

AUTOMATIC DISPLAY SHUT-OFF

To conserve battery power, your calculator automatically shuts off display, leaving a symbol lit in the exponent negative sign position approximately 15 seconds after the last key is pressed. Depressing any keys, except the DH keys, for continuing the operation, will turn the display back on. This feature is automatically disabled while the battery is being recharged, or while plugging the charger into the charger jack and may manually be disabled by the DH key.

LO-BATTERY INDICATOR

The built-in automatic *Lo-battery* indicator tells the exact time that the battery must be recharged when the battery becomes weak enough so that the data produced by the calculator could be in error. When the indicator is lit, immediately proceed to recharge. See **Maintenance of Rechargeable Battery**. Note: When the battery voltage becomes too low to energize the indicator, the indicator will not light up.

LEGAL ENTRY RANGE: $\pm 1 \times 10^{-9.9} \pm (10 - 10^{-9}) \times 10^{9.9}$

MANTISSA ENTRY OVERFLOW

If a data entry of more than ten integers or nine fractional mantissa digits is made, only the first ten integers or nine fractional mantissa digits will be accepted and displayed. In this status, all the function keys are operative, and the entered data may proceed to the function key for a desired calculation with no interruption, providing the number entered is not greater than $(10 - 10^{-9}) \times 10^{9.9}$ in magnitude. No indication of a symbol will result in this condition.

ENTRY ERROR

Entry of a number greater than $(10 - 10^{-9}) \times 10^{9.9}$ in magnitude will cause interruption to the calculator and a display of the **error** symbol immediately upon a function key being depressed.

PROHIBITED INPUT ARGUMENT (See Table 1 at the end of this manual)

- 16 The specific functions may not be performed over the full range of the number that may be entered, or

that may be developed as an intermediate result during calculations, without error. **Table 1** provides a summary of the prohibited range of arguments for such specific functions. An attempted function within the prohibited range of argument causes an immediate display of the **error** symbol, and interruption of further calculations which require the **C** key to release the **lock-up condition**.

RESULT OVERFLOW

Any calculation resulting in an answer greater than $(10 - 10^{-9}) \times 10^{99}$, that is $9.999999999 \times 10^{99}$, causes result overflow status to the calculator. In this status, the ten most significant mantissa digits and the two least significant digits of exponent will be displayed with the **error symbol**, if the function is performed within the permitted input argument range. In this status, the displayed result multiplied by 10^{+100} or 10^{-100} , depending on the exponent sign displayed, is correct.

ACCURACY OF THE SC-40

Any addition, subtraction, multiplication and division is subject to a truncation error of one count in the tenth least significant digit of the mantissa. This is caused when the 11th digit of the result is dropped for the round-off. These errors are cumulative and may produce successively larger errors with each additional operation.

The transcendental functions are subject to specific errors inherent in the process of the computation. **Table 2** shows the maximum error estimates in all cases.

Table 1 PROHIBITED INPUT ARGUMENT

Functions	Prohibited Argument Range
$X + Y$	
$X - Y$	
$X \times Y$	
$X \div Y$	$Y = 0$
X^2	
$\sqrt{X}$	$X < 0$
$1/X$	$X = 0$
X^Y	$X \leq 0, Y > (100 \cdot \ln 10) / \ln X $
e^X	$X \geq 100 \cdot \ln 10$
$\ln X$	$X \leq 0$
$\log X$	$X \leq 0$
$\sin X$	
$\cos X$	
$\tan X$	$ X = (90^\circ \text{ or } \pi/2) \cdot (2n - 1), n = 1, 2, 3, \dots$
$\sin^{-1} X$	$ X > 1$
$\cos^{-1} X$	$ X > 1$
$\tan^{-1} X$	

Note: Violation will result in an immediate display of the error symbol— "Γ" and "0."

Table 2 ACCURACY AND MAXIMUM ERROR ESTIMATES

Functions	Input Arguments	Conditions	Maximum Error
+			1 in D10
-			1 in D10
÷			1 in D10
X			1 in D10
X^2			1 in D10
$\sqrt{X}$			2 in D10
1/X			1 in D10
X^y	$10^{-9} < Y \cdot \ln X < 10^2 \cdot \ln 10$		6 in D8
e^x	$0 \leq X \cdot 10^r < \ln 10$		5 in D10
	$\ln 10 \leq X \cdot 10^r < 10 \cdot \ln 10$		2 in D9
	$10 \cdot \ln 10 \leq X \cdot 10^r < 10^2 \cdot \ln 10$		2 in D8
$\ln X$		$ r \geq 10$	1 in D10
		$ r < 10$	4 in D10
$\log X$		$ r \geq \ln 10$	2 in D9
		$ r < \ln 10$	4 in D10
$\sin X$	$0^\circ \leq X \leq 360^\circ$ or $0 \leq X \leq 2\pi$		5 in D9
$\cos X$	$0^\circ \leq X \leq 360^\circ$ or $0 \leq X \leq 2\pi$		5 in D9
$\tan X$	$0^\circ \leq X \leq 90^\circ$ or $0 \leq X \leq \pi/2$	$0 \leq X < 85^\circ$	5 in D9
		$85 \leq X < 89^\circ$	8 in D8
		$89 \leq X < 89.9^\circ$	8 in D7
		$89.9 \leq X < 89.99^\circ$	8 in D6
		$89.99 \leq X < 89.999^\circ$	8 in D5
		$89.999 \leq X < 89.9999^\circ$	8 in D4
$\sin^{-1}$	$10^{-10} \leq X \leq 1$	$0 \leq r \leq 90^\circ$	$< 3 \cdot 10^{-7}$
$\cos^{-1}$	$10^{-10} \leq X \leq 1$	$0 \leq r < 90^\circ$	$< 4 \cdot 10^{-7}$
		$90 \leq r \leq 180^\circ$	$< 4 \cdot 10^{-6}$
$\tan^{-1}$		$0 \leq r \leq 90^\circ$	$< 3 \cdot 10^{-7}$

Dn: The n-th least significant digit of mantissa.

r: The calculation result as displayed.

CARE OF YOUR SC-40

- Your SC-40 is supplied with a convenient protective carrying case. When your SC-40 is not in use, it should be enclosed in this carrying case to protect it from dust and other foreign material.
- When the calculator case needs to be cleaned, a damp (not wet), soft, lint-free cloth should be used. Dust and foreign material should be removed carefully to protect the keyboard.
- Your SC-40 should not be exposed to excessive heat or moisture.

IN CASE OF DIFFICULTY

- Recharge the battery. When the battery is completely exhausted, the *Lo-battery* indicator will not light up as the battery cannot energize the indicator.
- Check to be sure that the charger is correctly plugged into a proper outlet that has power.
- Turn the calculator off, and then turn it on, and press the clear key to reset every segment of logic devices and data registers in the calculator to zero.
- Review operating instructions again to be certain calculations are performed correctly.



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